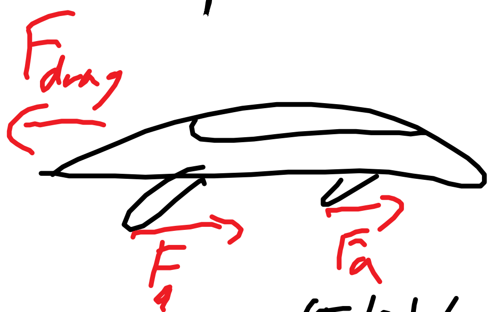
p 203

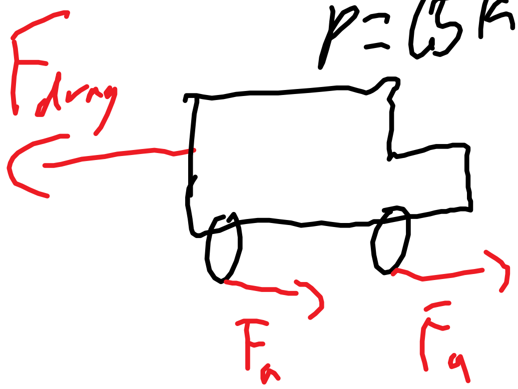
Q12

$P = 35\,kW$ $\quad v \rightarrow = 105\,km/h$

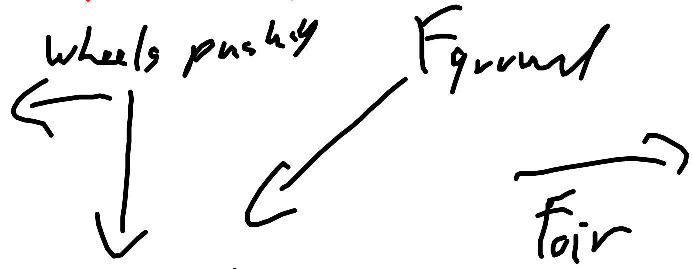
a)



$P = 65\,kW$ $\rightarrow 105\,km/h$



b) Ground



c) $P = \frac{W}{t} = \frac{Fd}{t} = $

$P = Fv$ $\quad F = \frac{P}{v} = \frac{35\,kW}{105\frac{km}{h}\left(\frac{1}{3.6}\right)}$

k $\quad \frac{km}{h} \rightarrow m/s$ $\quad F =$

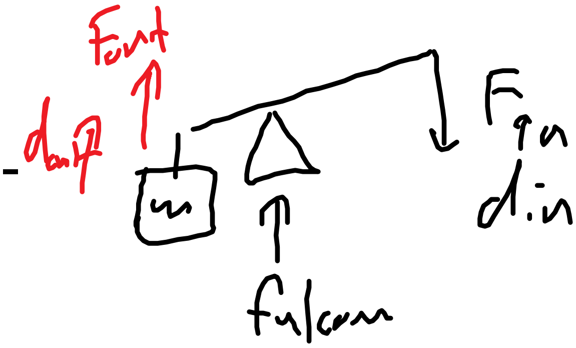
35000/(105/3.6)=1200 N = 1.2kN

65000/(105/3.6)=2228.5714 N
2.2kN

Simple Machines - Efficiency

A simple machine changes input force through a displacement into an altered output force and displacement.

examples: lever -



pulleys, screw, wheel and axel, ramp - wedge,

Define Mechanical Advantage as the ratio of the output force to the input force.

$MA = F_{out}/F_{in}$ it has no units

Efficiency is the ratio of the output work to the input work. Given as a percentage.

$\text{efficiency} = W_{out}/W_{in} \times 100\%$

Ideal mechanical advantage - mechanical advantage if the machine is 100% efficient.
100% = Wout/Win x 100%

so Wout = Win $F_{out}d_{out}=F_{in}d_{in}$ becomes
$F_{out}/F_{in}= d_{in}/d_{out}$
MA = F_{out}/F_{in}
IMA = d_{in}/d_{out}

eg. I push on a lever with 200.0N through a displacement of 15cm to lift a box 40.0kg through 5.0 cm. Determine:

a) weight of the box - this is the output force
   F=mg = 40x9.8=392 N
b) Mechanical advantage of this lever
   MA=Fout/Fin = 392/200=1.96 (no units)
c) Ideal mechanical advantage of the lever
   IMA = din/dout = 15/5=3.0   (no units)
d) the efficiency of the lever

efficiency = Wout/Win x 100% =
Foutxdout/Finxdin = 392x0.05/(200x0.15)=
0.6533 = 65% efficient.

Simple Machines - Efficiency

A simple machine is something that alters an input force into an output force.

The ratio of the output force to the input force is mechanical advantage.

MA = F_{out}/F_{in} it has no units (it is a ratio)

$MA = F_{out}/F_{in}$ it has no units (it is a ratio)

what are the types or examples of simple machines:
lever (jack, bottle opener)
pulley (elevators, cranes)
wedge (ramp, ax (axe), scissors)
wheel and axel (screw driver,)
screw (corkscrew,)

The efficiency is the ratio of the output work (or energy or power) to the input work (or energy or power) and usually given as a percent. The efficiency is always less than 100%. (some energy is lost to friction)

efficiency = Wout/Win x 100%

Ideal mechanical advantage, IMA, is when the efficiency is 100% then
$100\% = W_{out}/W_{in} \times 100\%$
$W_{out} = W_{in}$ since W=Fd then
$F_{out}d_{out} = F_{in}d_{in}$
MA = Fout/Fin

$F_{out}/F_{in} = d_{in}/d_{out}$

$IMA = d_{in}/d_{out}$

d is the displacement through which the force

d is the displacement through which the force acts.

eg. You want to jack up a car using a lever. You are lifting using 5.0 kN of force to lift the car 20.0cm. You have to push on the jack with only 0.50 kN of force but you have to push through 2.2m of distance.

a) What is the Mechanical advantage of the jack?
MA = Fout/Fin = 5.0kN/0.50kN = 10

b) What is the Ideal mechanical?

IMA = din/dout = 2.2m/0.20m= 2.2/0.2=11

c) What is the work done - by the jack? by you?
W_{jack}= Foutdout = 5.0kNx0.20m = 1.0 kJ
W_{you} = Findin = 0.50kNx2.2m = 1.1kJ

d) What is the efficiency of the jack?
eff = Wout/Win x100%
1/1.1=0.9091 x100 = 91% efficient